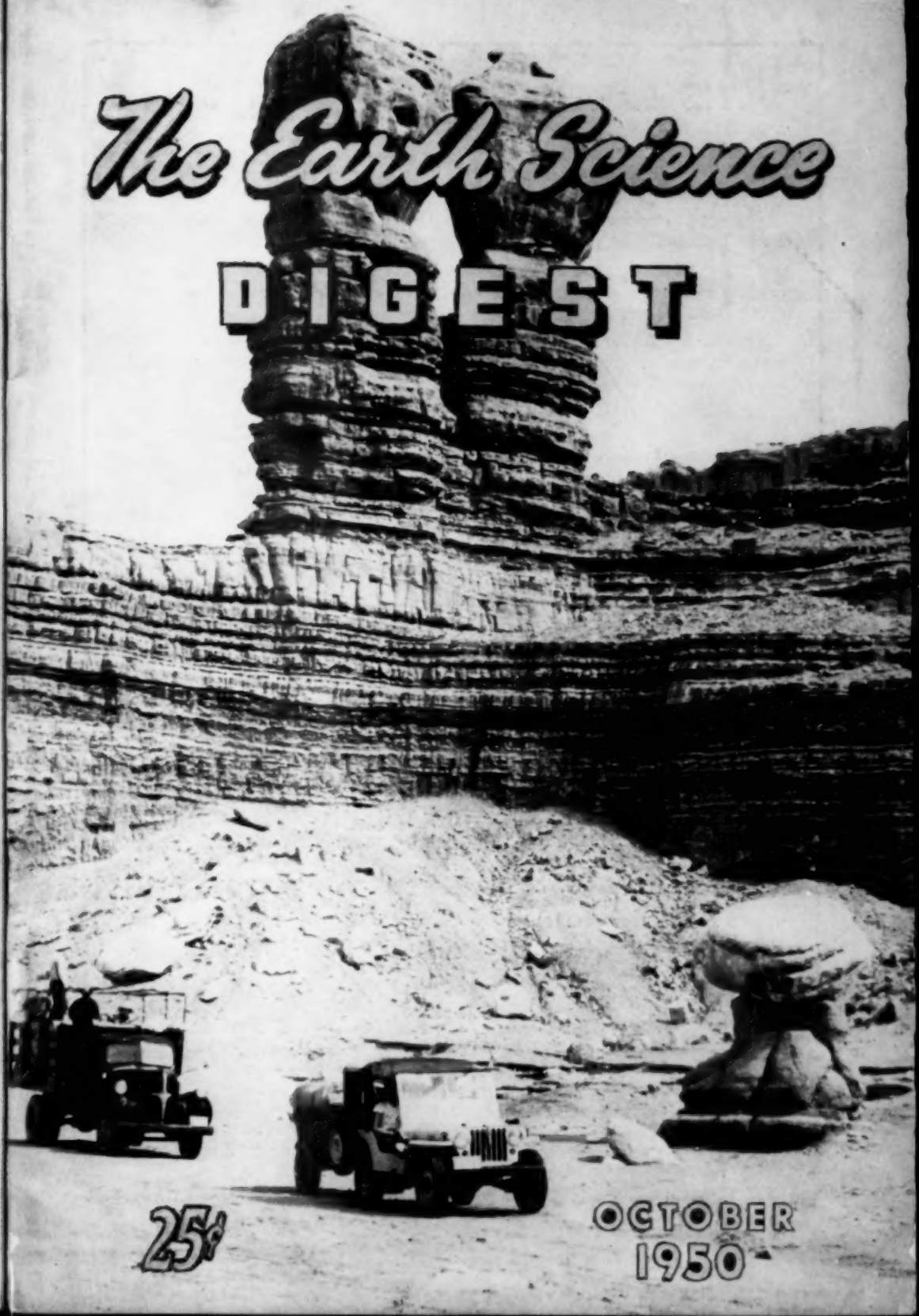
The Earth Science DIGEST



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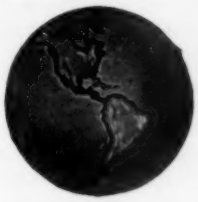

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Cover Photo

This month's cover photo was taken near Bluff, Utah, not far from the site of a recent uranium discovery, and a short distance from the San Juan River. The prominent features are the Kissing Rocks, and, below, Siesta Rock, named presumably from its resemblance to a sleeping peon. Photo by Henry P. Zuidema, University of Michigan.

NEXT MONTH

Geological Research in Finland — by Aarne Laitakari, Director, Geological Survey of Finland.

Geochemical Prospecting for Ores — — Part II — by Jerome M. Eisenberg.

AERIAL SURVEY DISCLOSES EXTENSION OF VERMILION RANGE IRON FORMATION

MINNEAPOLIS, Oct. 20 — Discovery of a previously unsuspected extension of the rich Vermilion range iron formation in northern St. Louis county was reported today by Dr. George M. Schwartz, director of the Minnesota Geological survey and a professor of geology at the University of Minnesota.

Aeromagnetic maps released today by the United States Geological Survey indicate that the hematite producing Vermilion range curves southeastward from the Tower-Soudan area into the roadless wilderness between Embarrass and Bear Head lake. Vermilion range hematite is a high-grade iron ore.

This new aeromagnetic picture of the Vermilion range justifies considerable exploration and drilling for possible iron ore deposits in an area of about 20 square miles southeast of Soudan, Dr. Schwartz believes. The area is covered by glacial drift to a depth of from 50 to 100 feet.

According to available geologic records, no previous exploration for iron ore formations has been carried on in this area.

Indications of the Vermilion range extension were found on one of three maps released today by the United States Geological Survey in connection with the cooperative aerial search by the U.S.G.S. and the Minnesota Geological survey for potential new iron formations which has been underway since 1947 in a 30,000-square-mile area in northern Minnesota.

The three new maps cover an area of approximately 1,800 square miles in eastern St. Louis county in which lie most of the Vermilion range and the eastern portion of the Mesabi iron range. Aeromagnetic maps covering approximately 25,000 square miles of the 30,000-square-mile area of the aerial "treasure hunt" have now been made available to the public, Dr. Schwartz reported.

Earlier maps resulting from the survey showed potential new iron formations in Hubbard, Cass, Becker, Otter Tail, Itasca and Aitkin counties. Mining engineers are now exploring some of these promising areas.

Maps released today (Oct. 20) also indicate, according to Dr. Schwartz, that a large igneous mass (molten rock) pushed up through the bed rock to the south of the eastern end of the Mesabi range sometime back in geologic history and "baked' the iron-bearing rock formation to the highly magnetic attraction in that area by converting the iron formation to the highy magnetic magnetite which is the principal iron-bearing mineral of taconite rock.

The aeromagnetic readings show that the earth's magnetic attraction in the vicinity of Babbitt at the eastern end of the Mesabi range is about three times that found in the Hibbing area farther west. It is at the eastern end of the range that the Reserve Mining Company plans to mine taconite which will be concentrated at Beaver Bay on Lake Superior before shipment to eastern steel mills.

Purpose of the cooperative survey is to determine the major magnetic trends associated with known deposits of iron ore in the state and thus to ascertain possible extensions of those deposits and to indicate new areas which may be favorable for further exploration in the hunt for ore.

"The necessity for aerial magnetic work," Dr. Schwartz explained, "arises from the problem of the thick glacial drift over much of northern Minnesota. Magnetic work on the ground has been carried on for a long time in the state, but the process is slow, and consequently, only selected areas have been covered. No one person or group has access to more than a fraction of the data thus compiled."

POTENTIAL MINERAL RESOURCES OF YUKON TERRITORY

H. S. BOSTOCK
Geological Survey of Canada

INTRODUCTION

In considering the mineral potentialities of Yukon Territory, certain factors in its history should be borne in mind. The Territory, first entered by prospectors in the 1880s, yielded the finest poorman's gold field in history in the discovery of the Klondike placer creeks in 1896. The great richness of the placers and ease of recovery of their gold led to the sudden development of that district and to the organization of a transportation system connecting it with ocean shipping at Skagway. At the same time, however, the idea became general that only gold could be profitably mined in Yukon, and the lack of interest in the rich silver veins on Galena Hill, which were known by many men for a decade before anyone sampled them, is an instance of its effect. This idea and the lack of any encouraging discovery of lode gold in the Klondike kept the search focused on placer gold, for which the Yukon south of Ogilvie Mountains has been well prospected. The local difficulties of lode prospecting in this northern country added to this narrow outlook and discouraged prospecting. The effective prospecting season is short. The percentage of rock exposure, everywhere small in the Cordillera, is even less in the Yukon, where bedrock is commonly covered by thick moss. Prospecting for lode deposits is largely confined to bedrock exposures, as trenching is hindered by the persistence of frost in the overburden. Except for trapping and some woodcutting, there is no industry within the Yukon by which an independent prospector can earn a grubstake in winter. As a consequence, would-be lode prospectors become primarily trappers or turn to the gradually subsiding placer mining for a living.

These and other factors have resulted in near stagnation of mining in Yukon, though its climate is the best of any area in the same latitudes in North America except, perhaps, the coastal region of the Gulf of Alaska. The geology of its terrain is favorable, as demonstrated by the numerous widely scattered and varied discoveries made despite the very little prospecting in progress. The main part of Yukon is within a 400-mile radius of Skagway, which is an ocean port, offering ease of access to world commerce throughout the year such as few other parts of Canada can rival. Such factors serve to explain the great mineral potentialities of the Yukon in spite of its small average annual production to date.

This article is reprinted in part from Paper 50-14 ("Potential Mineral Resources of Yukon Territory," by H. S. Bostock) of the Geological Survey of Canada, by permission of the Director of the Geological Survey of Canada.

GENERAL PHYSIOGRAPHIC AND GEOLOGICAL FEATURES

The main physiographic feature of Yukon is the broad basin-like Yukon Plateau, which occupies the central part of the triangular territory. Hyland Plateau, with Liard Plain and Plateau, both partly in British Columbia, in the southeast, and Porcupine Plain and Plateau in the north, comprise two smaller but similar basin-like areas in the acute angles of the triangle. These three relatively low-lying areas are separated from each other and bordered by mountains. Yukon Plateau is an elevated area in which scattered mountains and ranges rise above the general surface level. The plateau extends from northern British Columbia, in the southeast, into Alaska in the northwest. Selwyn and Ogilvie Mountains border the plateau on the northeast and north respectively, and Mackenzie Mountains stand behind Selwyn Mountains and extend eastward into Northwest Territories. The Coast Mountains project northwest into the southern part of the plateau, and St. Elias Mountains rise along the southwest border of the plateau on the Alaskan boundary.

The basin-like area to the southeast of Yukon Plateau is a broad wedge of subdued terrain that penetrates from the Interior Plains between the Rocky Mountains and Mackenzie and Selwyn Mountains. It consists of the broad, timbered Liard Plain, roughly centered around Watson Lake, and stretching east to Toobally Lakes; Hyland Plateau, a higher rolling area north of Liard Plain and at the southeast end of Selwyn Mountains; and Liard Plateau, another high rolling area south of South Nahanni River and between Toobally Lakes on the west and Liard River on the east.

In northern Yukon, the lowlying area beyond Ogilvie, Selwyn, and Mackenzie Mountains consists of Porcupine Plateau and Plain. These form a large basin, rimmed on the east by Richardson Mountains, which stand between it and Peel Plateau and Mackenzie Delta and lie mainly in Northwest Territories, and on the north by the British Mountains along the Arctic Coast. The basin opens westward into Alaska and has two other gaps in its periphery, one on the southeast along the fronts of Selwyn and Mackenzie Mountains and the other in the northeast between Richardson and British Mountains.

The main geological units coincide broadly with those of the physiography, but the similarity in topography of the Yukon Plateau and its satellite basin areas is not duplicated in their geology. Yukon Plateau is a rolling platform of metamorphic rocks largely of Pre-Cambrian age. Hollows in the surface of these old rocks contain folded Paleozoic and Mesozoic sedimentary and volcanic strata, and the whole complex is invaded by large and small bodies of intrusive rocks. Patches of Tertiary sedimentary and volcanic rocks rest on the surface of all these older rocks. The geology of Ogilvie and Selwyn Mountains and Hyland Plateau is somewhat similar, but Paleozoic rocks predominate and mantle the metamorphic rocks to a greater extent than in Yukon Plateau, and in general intrusive rocks form smaller and more scattered bodies. Much of Liard Plain is drift covered, but it contains Paleozoic sedimentary rocks overlain in places by basins of Tertiary sedimentary and volcanic rocks. Mackenzie Mountains and Liard Plateau are formed almost entirely of sedimentary rocks. The Coast

Mountains have as their core the Coast Range composite batholith of granitic intrusions. This batholith narrows northwestward and continues into Yukon Plateau more than a hundred miles beyond the mountains. It is bordered and patched with areas of the metamorphosed, sedimentary and volcanic rocks of the plateau, and is overlain by some Tertiary volcanic rocks. On the southwest, St. Elias Mountains contain great thickness of Paleozoic and Mesozoic strata of sedimentary and volcanic origins into which igneous rocks of great variety have been intruded, notably in the interior ranges. Tertiary volcanic and sedimentary rocks cover large areas in some parts of these mountains.

In the north, Porcupine Plateau and Richardson and British Mountains are composed of folded rocks, mainly marine sediments of Mesozoic and Paleozoic age. In addition, some Pre-Cambrian rocks and intrusions outcrop in parts of Porcupine Plateau. Porcupine Plain is underlain mainly by relatively flat-lying Mesozoic marine and continental sedimentary formations on which large patches of Tertiary sedimentary rocks rest.

Yukon Territory is also divisible into two regions distinct from each other in their recent geological history. The southern and eastern parts were largely covered by ice in Pleistocene or Glacial time, and the part lying broadly northwest of Carmacks remained free of glacial ice throughout that epoch and is referred to as 'the unglaciated area'. The glaciated areas are characterized by thick deposits of glacial drift, an irregular topography, and a disrupted drainage marked by lakes, canyons, and rapids. The unglaciated area carries a more even mantle of residual soils; its summits and valleys have more regular profiles; and lakes are few or lacking.

MINERAL AND FUEL BELTS AND AREAS

Before considering in more detail the several belts and areas, attention may be called to certain broad features of Yukon geology. An irregular belt of old rocks, partly metamorphosed and largely Pre-Cambrian in age, stretches from the northwestern United States through British Columbia and Yukon into central Alaska. In southern and central Yukon it has its greatest width, and the foundation of Yukon Plateau and the bordering mountain areas is formed mainly of these ancient rocks. Mineral wealth is associated with this belt in its more developed areas in the western United States and Canada. In British Columbia, the Sullivan mine at Kimberley, the leading mines of the Cariboo gold field, and many lesser mineral deposits, and in the Yukon most of the mineral discoveries and productive deposits, including the Klondike gold field and the Mayo silver-lead district, lie in it or near its borders. Indeed, the fact that such a large proportion of the Yukon is underlain by these rocks as compared with other Cordilleran regions is in itself an auspicious augury of its mining possibilities. In addition, the Yukon is favored by coal measures conveniently distributed in its southern and central parts, and by potential oil reserves in its northeastern part.

The mineral resources, including the natural fuels, are associated with specific geological areas and belts. Some of these have fairly definite boundaries, based on such features as the Coast Range batholith or the Laberge Mesozoic geosyncline. Others, lying mainly

in the less explored parts of Yukon, can be only vaguely outlined, and their delineation here is partly for convenience in description.

Broadly the belts and areas are divided into two groups, according as to whether they may contain mainly metallic minerals or natural fuels. Their positions are outlined on Figure 1.

MINERAL BELTS AND AREAS

St. Elias Mountains Area

About half of the St. Elias Mountains area is composed of a core of great, ice-bound ranges that rise in precipitous slopes far above the regional snowline and are penetrated by glacier-floored valleys. A few prospectors have explored the outer parts of the glacier valleys, but the inner vastness remains the field of prepared expeditions. It is the outer ranges along the northeast front of these great mountains that are accessible to prospectors and that are referred to here.

Except for the native copper of Kletsan Creek, which was used by the aborigines before the first white man entered the area in 1892, prospecting began in 1903 and brought the discovery of gold on many placer creeks that rise behind the first ridge of mountains along the northeast front. These creeks lie in a belt of relatively mature mountains, and occupy valleys whose floors, lying transverse to the direction of ice movement, were protected from scouring. The advent of the Alaska Highway has permitted the access of heavy machinery for placer operations, and has resulted in larger mining operations on three creeks during the past few years. The Highway also aroused fresh interest in lode prospecting. Though a great variety of metallic minerals have been found among the heavy placer concentrates, including those of copper, lead, silver, and platinum, lode prospecting has only yielded discoveries of copper, which occurs abundantly in the placers in native form. It has been found in lode prospects in the White River part of the area, between Donjek River and Kluane Lake, and south of Kathleen Lakes. It is also significant that the Kennicott copper deposit in Alaska lies in the western extension of the area. Float of copper and molybdenum sulfides has been found on Wolf Glacier, and sulfide minerals are reported in the mountains south of the glacier. Beds of gypsum outcrop on the northwest side of Slims River near the Alaska Highway. The numerous and varied types of intrusive bodies in the area bear witness to its mineral possibilities.

Coast Mountain Belts

Two mineral belts follow the southwest and northeast contacts of the Coast Range batholith, and are distinguished in the developed areas of British Columbia and southeastern Alaska where they contain many great mines, including among others the Pioneer, Premier, Britannia, and Treadwell Alaska. These belts continue into southwestern Yukon, and are shown as the Coast Mountains belts on Figure 1.

The southwestern contact belt in Yukon has yielded no production except some placer gold from a number of creeks, including Fourth of July Creek, but is known to contain showings of lode gold, copper, tungsten, and molybdenum. Practically no lode prospecting has yet been done on this belt, although in southeastern Alaska it has yielded considerable mineral wealth and similar possibilities

can be expected of it in Yukon.

The northeastern contact belt in Yukon has produced $2,711,695 worth of lode copper from the Whitehorse copper belt, mentioned above, the Wheaton district, and the Windy Arm district. The first is primarily a copper area, and several small copper mines owned by separate companies were successfully operated during the period of 1905 to 1920.

The Wheaton district contains a variety of lode prospects, including some of gold, silver-lead, copper, zinc, antimony, and fluorspar. Several gold and silver-lead properties were prospected in this area, but their value has not been proved. The antimony deposits are of particular interest. They occur along a zone from Lake Bennett to the northwest side of Wheaton River. In this zone several persistent veins and many small showings have been found. Good mining widths of ore carrying as much as 30 per cent antimony were uncovered, but sulfides of other metals are mixed with those of antimony and prevent the ore from competing with natural ores free of undesirable metals. It is probable that the successful operation of one property in the district would result in the development of several.

A number of gold-silver-lead veins have been discovered in the Windy Arm area near the British Columbia boundary. Considerable work has been done on some of them, but they appear to be judged as marginal deposits in the face of estimated costs of operation.

Where the north-east contact belt crosses the Alaska Highway it has received little attention, but is known to contain copper prospects similar to those of the Whitehorse copper belt. As the Coast Range batholith continues northwest into Yukon Plateau it passes first into an area of nearly continuous drift and thence, beyond Aishihik Lake, into an almost treeless, mountainous region difficult for the individual prospector to explore. Here it remains unprospected though its geological setting affords promise of mineral wealth.

Cassiar Mountains Area

The granitic rocks of Omineca and Cassiar Mountains extend northwesterly into southern Yukon from central British Columbia, where a great number and variety of mineral deposits, notably that of the Pinchi Lake mercury mine, are associated with them. Where they are crossed by the Alaska Highway, silver, gold, lead, and zinc prospects have been found in the last few years along both sides of, and in, the batrolithic rocks, but chiefly along their northeast flank, by individual prospectors and by company prospecting organizations. Tungsten and tin have also been revealed in assays from samples obtained from this area. It was the first placer mining area in Yukon, but was never important as such. Until the Highway was built it received no attention from lode prospectors, and at present is only being prospected near this great thoroughfare. It includes areas of old metamorphic rocks as well as a thick section of limestone, dolomite, shale and sandstone, and forms part of the same general belt west of the Rocky Mountain Trench as that containing the highly metalliferous Selkirk and Purcell Mountains, by which its potentialities are judged.

Pelly Mountains Area

The Pelly Mountains area is a large mountainous tract of almost unexplored country projecting into the Yukon Plateau. Except along its borders close to the main

streams of Teslin, Nisutlin, Pelly, Frances, and Liard Rivers, it has been difficult to reach and hard to penetrate. With the building of the Canol Road across it and the use of suitable aircraft, much of it is now relatively accessible for prospecting and could be made so for development. The area contains granitic bodies in prolongation of the axis of the Cassiar batholith, and also basic and ultrabasic rocks, all intruding a huge folded section of strata including metamorphic rocks of Pre-Cambrian age and Paleozoic and Mesozoic strata.

In 1898, the rich gold placers of the Livingstone Camp were discovered on the west border of Pelly Mountains, and since then many small placer creeks have been discovered in its most accessible part between Teslin River and Quiet Lake, and, indeed, gold has been found on many rivers and creeks around this mountain area. The direction of Pleistocene ice movement shows that the fine gold of Cassiar Bar on Yukon (Lewes) River came from the vicinity of Livingstone Creek. A similar setting is apparent for the bar gold of Stewart and McQuesten Rivers. However, though bar gold occurs on Pelly and Lapie Rivers on the north border of this area no rich source creeks have been discovered.

Deposits containing copper, gold, and asbestos have been found on the Teslin slope, and large veins of barite outcrop near the Canol Road on the northeast border of Pelly Mountains.

Dawson Range Area

A relatively well-defined mineral area along Dawson Range has produced small amounts of placer gold and tungsten, and lode gold, silver, and copper. Up to 1931, except for the small copper production, it was known only for its few small, scattered placer deposits, but in that year a gold-bearing copper-magnetite deposit was discovered by a trapper on Freegold Mountain. Lode prospects of gold, silver-lead, lead-zinc, copper, and antimony were soon found in the neighborhood of this discovery.

Sporadic lode prospecting spread from the original area, and 15 miles south of the Laforma led to the discovery of the Brown-McDade property, on which much development work was done in 1947. The operators realized that this was a large deposit requiring extensive exploration to prove its value, and it has remained inactive since November 1947. However, work on the property stimulated prospecting in the neighborhood, and resulted in a wealth of discoveries, including several veins similar to, and within a few miles of, the Brown-McDade, and several other lode gold, silver, and lead prospects in the surrounding country. These recent discoveries and those around Freegold Mountain constitute the prospects in the southeast and most accessible end of the Dawson Range.

Beyond Freegold Mountain, the area stretches northwest for 100 miles, and distribution of the mineral discoveries shows a close relationship to accessibility from Yukon River. Some $30,000 or more in gold and a few thousand pounds of tungsten have been recovered from the placer creeks, notably Canadian Creek. Lode prospecting has revealed a small silver-lead vein and some tungsten. Trappers have brought in specimens of vein matter carrying gold, silver, lead and fluorspar from scattered localities in the area.

Klondike Area

The Klondike area includes the Klondike placer mining district

and a wide belt of similar terrain around it. It occupies a large part of the unglaciated country south of Ogilvie Mountains, and has produced more than $215,000,000 in gold, as well as a large quantity of silver as a by-product of gold refining. The richer gold placers are being steadily depleted, but improvements in mining methods and exploration and the increase in the value of gold have from time to time prolonged their life. The same factors in recent years have extended large scale operations to creeks outside the immediate Klondike, and several dredges and other operations dependent on mechanical equipment have been established. Mining operations, however, in the Klondike itself and close to Dawson have a great advantage in the supply of hydro-electric power generated from North Klondike River. Small amounts of other metals, such as mercury, lead, tin, and platinum, occur in the gold placer deposits of this area, but no placer prospecting except for gold has been attempted, and it is not improbable that some creeks poor or lacking in gold in this unglaciated area may contain concentrations of other valuable heavy minerals.

Several lode gold prospects are known in the Klondike area, particularly in the Klondike placer field itself, but none has yet proved economic, though the geology resembles that of the Cariboo district of British Columbia where lode gold production has successfully followed placer mining. Silver-lead and antimony veins of good grade have been found in several places; mercury has been found in the gold placers and in small veins at the head of Sixtymile River; and asbestos is associated with serpentine bodies north of Fort Selkirk. It is apparent that further prospecting in this area may be expected to result in lode mining of gold and one or more other metals or minerals.

Pelly Plateau Area

No prospects of sufficient merit to attract mining interest have been found in the Pelly Plateau area. No feature of its geology, however, invites a pessimistic attitude towards this area. Indeed, its rocks and their structure and relationships are favorable, and seem more promising than those of some areas that have received more attention. On the other hand, it must be admitted that, prior at least to the building of the Canol Road, the area was relatively remote. Most of it too was intensely glaciated, so that no gold placers of consequence have been discovered in it, and much of the area is covered by drift.

Mayo Area

Mayo area has produced silver, lead, gold, and tungsten to the value of about $28,000,000. This has come mainly from the silver-lead veins of Galena and Keno Hills, but includes more than $2,000,000 in placer gold and about $10,000 in placer tungsten. Lode deposits containing zinc, gold, antimony, copper, and tin as their principal metals have also been found in the area, and, in addition, veins containing clear quartz crystals. Further, mercury, tin, bismuth, monazite, and hematite occur in the placers.

The lode production has been won from high-grade silver-lead veins for which little underground prospecting was done until recently, the life of the camp being maintained through the continued discovery of veins at the surface or new pockets of ore underground rather than through efforts to

deevlop reserves or explore possibilities of deposits. In the past few years, however, planned exploration has yielded spectacular results in thediscovery of ore bodies and reserves, which have necessitated mining and milling on a larger scale.

In Mayo area, placer and lode deposits are grouped around or close to intrusive stocks of granodiorite that lie to the west of the region deeply scoured by glaciation. These stocks are aligned in a direction a little south of east in two parallel belts across the area. They continue into the Selwyn Mountains area where glaciation was more intense and where, in consequence, no workable gold placers have been found and as a result little exploration has been attempted. In the Beaver River section, which lies 70 miles north of Mayo, partly in the Mayo area and partly in the Selwyn Mountains area, high-grade lead veins, carrying less silver than those on Galena and Keno Hills, have been prospected, and a few hundred tons of lead ore from them has been mined and brought out by tractors and sleighs to Mayo for shipment. This section is the exception to the rule of 'no placer gold, no prospecting,' perhaps due to the fact that the first veins discovered were particularly well exposed.

Cassitererite, a tin mineral, occurs in the gold placers, and has also been discovered in a vein at Dublin Gulch. Tin has also been revealed, spectroscopically, as a constituent of the granodiorite from that locality. Its distribution in the Mayo area suggests that it occurs with intrusions to the eastward in the Selwyn Mountains area, and leads to the belief that workable lode tin deposits will be found associated with one or other of these stocks.

Selwyn Mountains Area

The Selwyn Mountains area includes Hyland Plateau, which joins the south end of the mountains. This great area, more than 500 miles long, is divided here into three parts, Hyland Plateau and Logan Mountains in the south, Hess Mountains in the middle, and Wernecke Mountains in the north.

In the south the geology of Hyland Plateau appears similar to that of Logan Mountains, so these two parts will be described together. The plateau is relatively accessible, being close to the Alaska Highway, but it is largely covered by drift. It and Logan Mountains, comprising an area of about 25,000 square miles, including the parts in the Northwest Territories, have never been traversed by a geologist. For many years placer gold has been known in streams along the divide between Pelly, Hyland, Coal, Rock, and Beaver Rivers in Yukon and Flat and Caribou Rivers and other tributaries of South Nahanni River in Northwest Territories. During the last two decades this knowledge has attracted prospectors to the area south of the 62nd parallel and has resulted in the discovery of deposits carrying lead and copper, and in a report of an occurrence containing tin. The geology of this southern section of the Selwyn Mountains area appears favorable for prospecting, and during the last two or three years some companies have been exploring discoveries along the accessible southern fringe of Hyland Plateau.

North of Logan Mountains, Hess Mountains are as little known. Their western border has been explored, and in the south they are traversed by the Canol Road. No

mineral discoveries of interest have been reported.

Very little is known of the area as a whole, but scattered geological explorations show that the formations along its southwest side are very similar to those of the Mayo area, and, as already mentioned, the same types of mineral deposits may be expected in it, including tin deposits. Important prospecting zones are anticipated around some of the many granitic stocks scattered in its mountains. The general features of the geology bear a resemblance to those of the Kootenays in southern British Columbia. To date, the northwest part of the area has received most attention, and discoveries of iron, copper, gold, silver, lead, zinc, iceland spar, and quartz crystals have been reported by trappers. Of these, the iron- and copper-bearing deposits are of particular interest.

Bedded hematite iron formation is associated with Late Pre-Cambrian (?) strata in this general region from the 141st Meridian in the Ogilvie Mountains area, in the northwest, to South Nahanni River in the southeast, at intervals along a broad arc about 550 miles long. Where actually sampled in place on the 141st Meridian and near the Canol Road, the grade of the iron formation is low, but northeast of Mayo between Wind River and the Head of Stewart River the iron formation is said to be of good ore grade. Some of the specimens are of nearly pure hematite. No one has described this ore in place northeast of Mayo except the late Livingstone Wernecke of the Treadwell Yukon Corporation, who stated that the iron formation near the head of Bonnet Plume River was several hundred feet thick and could be traced from the air for 130 miles southeasterly through the mountains. By following the best grades, a railway to this locality from Skagway would be less than 500 miles long. On this route to the sea it would pass through the Laberge Mesozoic coal area (**See** below) as well as the Mayo area. So far as known this iron formation constitutes the one great, possible, iron ore reserve within 500 miles of the Pacific Ocean in either North or South America.

West of Wind River trappers have reported a belt of greenstone or trap rock. Here the chief heavy mineral in the streams is chalcopyrite, and this mineral also occurs in place in the greenstone. Nothing definite is known of the size of this belt, but its existence points to the possibility of economic copper deposits.

Ogilvie Mountains Area

Despite its general proximity to the Klondike, the Ogilvie Mountains area has been little prospected. Several intrusive granitic stocks lie in its southwest flank, and around these mineral occurrences containing gold, silver, lead, and antimony are known. But most of the area constitutes one of the least explored parts of Western Canada. Trappers have reported placer gold and gold-bearing quartz veins on its northern slope toward the head of Peel River. Iron formation is known to outcrop near both ends of this area, on Wind River and the 141st Meridian, but it is not known whether it is exposed or underlies younger rocks within the mountains.

Northern Area

The northern of the smaller basin-like areas, referred to at the beginning of this report, north of Ogilvie, Selwyn, and Mackenzie

Mountains, is one of the least known areas of Yukon Territory. It comprises an isolated unit, more arctic in climate, more difficult to travel in, and distinct in many physiographic and geological characteristics from the main part of the territory to the south. It is occupied mainly by Paleozoic Mesozoic, and Tertiary strata: in consequence its resources are mainly non-metallic and the greater part of it is dealt with later under 'Fuel Belts and Areas'.

A few dikes are reported in Richardson Mountains, and on the west side of Mackenzie Delta, near Mount Goodenough in Northern Territories, a small intrusion carrying copper sulfide is reported. This occurrence suggests that other intrusions may be present in the broad, unexplored, northern part of these mountains within Yukon Territory.

FUEL BELTS AND AREAS

St. Elias Belt

A belt of ten or more detached basins of Tertiary sedimentary rocks containing lignite deposits follows an irregular valley-like feature, the Duke Depression, parallel with and behind the main front ranges of the St. Elias Mountains. These basins have not been mapped, and only two or three of them have been visited by geologists. As many as thirty seams, mostly thin but including a few 3 to 14 feet thick, are known in one of them, and seams several feet thick have been reported in two others. It is believed that most of these basins contain seams of workable thickness.

In addition, in the last 2 years, a belt of late Mesozoic strata has been mapped by the Geological Survey in the front ranges between Jarvis and Tatshenshini Rivers. These rocks include numerous thin coal seams, and as the parts of the formation containing the coal are poorly exposed it is possible that workable seams are present.

Laberge Mesozoic Area

A large geosyncline of Mesozoic strata extends northwestward into the platform of metamorphic rocks of the Yukon Plateau from near the British Columbia boundary, and its upper part contains coal measures. A series of basins of these coal measures has been roughly mapped along the southwest and northeast flanks of this geosyncline. The upwarped central part of the structure is largely composed of the Mesozoic strata underlying the coal measures. The principal coal seams are of Lower Cretaceous age, but some are of Jurassic age. The Cretaceous coal has been mined where it is convenient to Yukon River steamboats at Carmacks, and is of bituminous and semi-bituminous rank. Only this one basin has been examined with any interest, and it appears to be one of the smaller ones. The coal in it is non-coking. For thirteen of these Mesozoic coal basins, estimates totalling 231, 160,000 tons of possible and probable coal in seams more than 3 feet thick are given in the report of the Royal Commission on Coal.* These coal areas are well placed in the more accessible central part of southern Yukon.

Tintina Valley Belt

Tintina Valley is a great, trench-like valley traversing much of southern Yukon from Pelly River near Ross River Past northwest-

*MacKay, B. R.: Coal Reserves of Canada; Reprint of Chapter 1 and Appendix A of Report of Royal Commission on Coal, 1946 (1947).

erly to pass a few miles north of Dawson and thence into Alaska along Yukon River Valley. The northwest 100 miles or more of this valley in Yukon Territory is floored by Tertiary sedimentary rocks containing seams of lignite. This long, trough-like area of coal measures constitutes a great reserve of lignite in a relatively accessible part of Yukon. The report of the Royal Commission on Coal estimates 112,000,000 tons of probable and possible lignite for one-tenth of its conservatively estimated area. The lignite has been mined in three localities and found to be of good grade.

It seems probable that with more geological exploration and mapping other, though smaller, basins of Tertiary lignite-bearing sediments will be found farther southeast along Tintina Valley.

Liard Plain Area

Liard Plain is one of the outstanding broad hollows in the western mountains of Canada. It is largely drift covered, and though it has been examined by the Geological Survey along the Alaska Highway and Liard and Francis Rivers, the geology of its broad expanses is little known. In places along the Highway and rivers Tertiary sediments with lignite seams have been found. The Royal Commission on Coal gives those in Yukon Territory an area of 5 square miles and total of 3,730,000 tons of probable and possible mineable coal, but it would not be difficult to envisage, within the wide expanses of Liard Plain in Yukon Territory, 100 square miles or more of these lignite-bearing measures.

Liard Plateau Area

Liard Plateau is underlain by much the same geological formations as those of the Rocky Mountain Foothills, and similar resources of coal and oil may yet be found in it.

Northern Coal and Oil Areas

Little is known of Yukon Territory north of the Ogilvie Mountains. However, this arctic terrain is characterized by a few, large, relatively simple features, and, consequently, it has been assumed that information gained on any part of one of these features is generally applicable to the whole feature.

The coal and oil potentialities are treated separately. For coal, there appear to be three large Mesozoic areas and five smaller Tertiary areas; four of the latter may overlie parts of Mesozoic areas.

The coal areas are as follows:

Mesozoic coal areas

- Peel Plateau area
- Porcupine River area
- Arctic coast area

Tertiary coal areas

- Bonnet Plume area
- Snake River area
- Old Crow area
- Bell River area
- Old Crow Plain area

Mesozoic Coal Areas

Peel Plateau Area. Continental Cretaceous sediments including seams of lignite outcrop in the banks of the lower part of Peel River in Yukon Territory. These rocks are believed to be the surface formation of Peel Plateau on each side of the river over an area, in the Territory, of more than 1,200 square miles, so that a large reserve of this coal is possible.

Porcupine River Area. In the Porcupine Plain the same conti-

nental Cretaceous beds as those of Peel River and the Arctic coast occur in places along Porcupine River from Rock River on the east to near Old Crow village in the west. The plain includes about 8,000 square miles in which areas of these strata may occur near the surface, but as underlying, older strata and overlying Tertiary beds are present in places along the river it is probable that the occurrence of the Cretaceous coal measures is restricted to partly covered synclinal basins and will only be accessible for mining where they are not covered by Tertiary beds.

Arctic Coast Area. Continental Cretaceous sediments resembling those of Peel River form the Arctic coast, including Herschel Island, of Yukon Territory for a distance of more than 100 miles. They extend inland at least 20 miles, and may outcrop in synclines to the south in the broad gap of the Arctic Plateau between Richardson and British Mountains. Lignite has been mined from these beds at Moose River, a few miles west of the Yukon-Northwest Territories boundary, and outcrops of lignite have been found on Babbage River 50 miles to the west.

Tertiary Coal Areas

Bonnet Plume Area. A basin of Tertiary sediments outcrops on the lower reaches of Bonnet Plume and Wind Rivers. It contains many seams of lignite, including one 40 feet and others 9 feet thick. The area of these strata is approximately 400 square miles, so that a large reserve of coal may be present.

Snake River Area. A group of high, isolated plateaux, or mesas, of horizontal strata, only observed in air photographs, stands above the general surface of Peel Plateau on both sides of the Yukon - Northwest Territories boundary about 10 to 15 miles north of the front of Mackenzie Mountains between Bonnet Plume and Arctic Red Rivers. In the Yukon the mesas have an aggregate area of between 100 and 200 square miles. No one has explored them, but they appear to be formed of 500 to 1,000 feet of strata resting on the plateau, which is formed of Cretaceous and older rocks. From these factors it is thought that the mesas may consist of Tertiary strata, perhaps the same coal measures as those of the Bonnet Plume area.

Old Crow Area. Two basins of Tertiary strata overlie Cretaceous formations along Porcupine River on each side of the village of Old Crow. These strata are probably part of the same group as the Tertiary coal measures of the Bonnet Plume area, and, though in their few exposures along Porcupine River no coal outcrops, it is probably present.

Bell River Area. This is a broad hollow of about 400 square miles, and no outcrops are recorded along the rivers in it. Its surface resembles those of the areas of Tertiary rocks of the Old Crow area, and it is reasonable to suppose that it is underlain by the same strata.

Old Crow Plain Area. North of a ridge of hills that extend eastward from the Old Crow Range on the north side of Porcupine and Driftwood Rivers, Old Crow River drains the broad flat of the Old Crow Plain. This plain is part of the larger Porcupine Plain, and has an area of about 1,500 square miles. No examination has been

made of it. Its surface, nearly half of which is covered by ponds and small lakes, is known to be composed of unconsolidated deposits of gravel and silt covered by a thick layer of peaty vegetable material. It is probable that in this area, too, Tertiary strata containing coal measures are present and lie beneath the superficial deposits.

Petroleum in Northern Yukon Territory

The region in Yukon Territory north of Ogilvie, Selwyn, and Mackenzie Mountains was almost ignored in the search for oil during the period of the Canol project in 1942 and 1943, chiefly due to remoteness from the Canol pipeline. As a result, only those parts of the region east of Richardson Mountains adjoining the MacKenzie River area and along the Arctic Coast have been referred to in publications as having oil possibilities.

The region lies at the northeastern terminus of the North America Cordillera, where the northwesterly trending structures of Western Canada meet the northeasterly trend of the mountain ranges of Alaska. This circumstance is reflected in the structure and physiography of the region. The dense mass of mountains to the south, with their closely spaced structures, give place here to more open and subdued topography, with broad hollows bordered by low ranges within a terrain commonly regarded as largely mountainous. In this region, some mountain ranges, Richardson Mountains and the easterly parts of British Mountains and Keele Range, may contain local oil reservoirs as they appear to have more open structures than the ranges to the south, their rocks are believed to be mainly marine sediments of Mesozoic and Paleozoic ages, and intrusions are relatively few or lacking. However, the possibility is remote, and it is the broad piedmont plateaus and intermontane basins and plains, where the sedimentary sections appear to be thicker and the structures more open, that are considered to hold practical possibilities for oil reserves.

In conclusion, the potentialities for oil in northern Yukon can only be appraised from meagre information, but this indicates some possibilities of oil reservoirs. Eagle Plain, occupying an area of about 5,000 square miles, and Peel Plateau east of Richardson Mountains are regarded with the most favor, but the border areas on the east, northeast, and south of Porcupine Plain as a whole also have possibilities.

New Jade Occurrence In California

Jadeite and nephrite jade recently have been found associated together in stream boulders from the North Fork of the Eel River, Trinity County, California. The find was made by geologists of the Tidewater Associated Oil Company and confirmed by members of the California Division of Mines and California Academy of Sciences. The jadeite is light mottled green and gray and does not resemble the San Benito County material; associated nephrite is dark green. Boulders of jasper and crocodolite are found with the jade and are from the same source rocks; none of the material, however, has been found in place. The crocidolite is not easily recognized on weathered surfaces because of iron oxide alteration products. (From Mineral Information Service, Vol. 3, No. 10, Oct. 1, 1950.)

DEPARTMENT
OF
MINES AND TECHNICAL SUR
GEOLOGICAL SURVEY OF CANADA

LEGEND

Assumed boundary of mineral belt or area

Mineral belt or area (12)

LIST OF MINERAL BELTS AND AREAS

1 St Elias Mountains area
2 Coast Mountains belts
3 Cassiar Mountains area
4 Pelly Mountains area
5 Dawson Range area
6 Klondike area
7 Pelly Plateau area
8 Mayo area
9 Selwyn Mountains area
10 Ogilvie Mountains area
11 Northern area

FIGURE 1A. MINERAL BELTS AND AREAS

FIGURE 1.
MINERAL AND FUEL BELTS AND AREA

SCALE OF MILES
100 0

DEPARTMENT
OF
S AND TECHNICAL SURVEYS
EOLOGICAL SURVEY OF CANADA

FIGURE 1B. FUEL BELTS AND AREAS

FIGURE 1.
LTS AND AREAS OF YUKON TERRITORY
SCALE OF MILES
100 200 300

RADIOCARBON CALENDAR SHOWS OLDEST EVIDENCE OF MAN IN AMERICA

WATSON DAVIS
Director, Science Service

SCHENECTADY, N. Y., Oct. 12 — Woven rope sandals found in a lava-covered Oregon cave become the oldest articles associated with man in the Americas as the result of the radiocarbon atomic calendar presented to National Academy of Sciences here this morning by Drs. William F. Libby and James R. Arnold of the University of Chicago's Institute of Nuclear Studies.

These sandals are approximately 9,000 years old. The ancient Americans who wove them and wore them become the oldest proved inhabitants of this continent, dating back to 7000 B. C. This probably antedates the oldest agricultural village in Iraq, which radiocarbon dating of shells found there, also reported this morning, show to be at least of the period 5000 B. C.

The greatest upset in American antiquity resulting from the radiocarbon dating is in the age of charcoal from a fire-pit presumably associated with Folsom man, to whom ages of from 10,000 to 20,000 years had been assigned. Dr. Libby's very sensitive Geiger-type counter showed the "surprisingly young" average age of about 4,300 years.

This makes the Folsom inhabitants actually more recent than people who built fires in Frontenac and Lamoka regions of New York State about 5,000 years ago, by the radiocarbon dating. The oldest Indian mounds in Kentucky have about this same age, as shown by analysis of shells and deer antlers. These are the oldest evidence of human beings in eastern America.

The method of radiocarbon dating is based upon the determination of the amount of radiocarbon or carbon 14 in the organic material being tested. This radioactive carbon is created in the upper atmosphere when cosmic rays strike the hearts or nuclei of nitrogen atoms. Some of this carbon reaches earth and is absorbed through food and water by plants and animals during their lifetime.

The radioactivity is lost at a constant rate, half of it disappearing in 5,568 years with a possible error of 30 years in this half-life of radiocarbon. The amount of radiocarbon in the organic remains thus provides an index to the date that they were formed. The method is accurate to within approximately a hundred years. All but a minute amount of radiocarbon is gone after 25,000 years and the Libby method can not date objects beyond that span.

Some 300 organic objects were selected about a year and a half ago by a committee of experts as most significant for dating and Dr. Libby reports now on 159 of these. In each case a minimum of an ounce of material is necessary. Refined methods of chemical separation are needed to obtain the radiocarbon which is counted over a period of 48 hours.

The Ice Age of the U. S. Middle West was more recent than generally estimated by geologists. Instead of being 20,000 years ago, the radiocarbon evidence shows that it was 12,000 years ago. The glacial epoch was apparently contemporaneous in Europe, for

samples from Ireland, England and Germany agree closely with the Wisconsin dating of the final phase of the ice cap.

Man's first proven existence in North America was 10,000 years ago, shortly after the glaciers receded. These first known humans were in Oregon and Nevada, and there is no evidence of man on the east coast until 5,000 years later.

The giant sloth lived in Gypsum Cave, Las Vegas, Nev., about 10,500 years ago, as analysis of its dung shows. Presumably man there was contemporaneous.

A fishweir unearthed three years ago in Boylston Street, Boston, is believed to be about 5,000 years old, contemporaneous with the record-age discoveries in New York State and Kentucky, judging by analyses of the peat underlying and the wood overlying it.

Burned bones of giant sloths, horses and the camel-like guanaco, which were associated with human bones and artifacts in Chile at the tip of South America, were dated as about 8,500 years old. These are the most ancient of the human samples from South America and are contemporaneous with the Gypsum cave culture in North America.

Crater Lake in Oregon is dated as 6,500 years old by an analysis of remains of trees killed by flowing lava from the volcanic explosion that created it.

Charcoal from the famous Lascaux cave in the Dordogne, France, which has remarkable paintings made by early man in Europe is dated as about 15,000 years old.

All of Dr. Libby's dates are given in detail with the finding of individual samples and their averages, each with a possible error that runs several hundred years in most cases.

DISCOVER EVIDENCE OF FOURTH LARGE GLACIER IN THE SIERRAS

LOS ANGELES, Oct. 12 (Science Service) — Discovery of evidence that a large glacier descended both the east and west slopes of the Sierra Nevada Mountains approximately 1,000,000 years ago was announced by Dr. William C. Putnam, professor of geology at the University of California at Los Angeles. Three previous glaciers have been known by geologists to have been active in the Sierra in Pleistocene times. This is the fourth — and largest — that has been found. This quartet of California glaciers, says Dr. Putnam, is not related to ice advances in the eastern and middlewestern United States.

The U. C. L. A. geologist made his discovery in a tunnel being driven through the mountains in the Owens Gorge, near Bishop, Calif., by the Los Angeles Department of Water and Power engineers. Nearly 400 feet of volcanic ash covered the glacial deposits, revealing periods of active volcanism between the various ice advances.

This part of the eastern Sierra is one of the most actively-faulted areas in the world. Hundreds of fault marks are to be found in this region which was a highly volcanic area in the recent geologic past. Deposits left by the final ice advance have been cut by faults, showing that this activity is even more recent than the California ice age.

Earth Science Abstracts

[Selected articles on the earth sciences, appearing in current scientific publications, are abstracted here for the convenience of our readers.]

PHYSICAL GEOLOGY

GEOLOGY OF GATUN LAKE AND VICINITY, PANAMA. Steward McReddie Jones. **Geol. Soc. Am. Bull.,** v. 61, no. 9, p. 893-922, Sept. 1950. "Gatun Lake and environs embraces about 650 square miles, in which the oldest rocks are closely jointed, folded, and partly metamorphosed pre-Tertiary Basement Complex. Over this old rock mass in the lower areas lies a Tertiary sequence of sedimentary, igneous, and pyroclastic rocks ranging from Eocene to late Upper Miocene. Quaternary deposits of unconsolidated sediments ranging from Pleistocene to Recent fill broad drowned areas and principal river valleys, locally to at least 300 feet below sea level. All sedimentary formations are fossiliferous..."

THE ORIGIN OF THE EARTH. Thornton Page. **Smithsonian Rpt. for 1949,** p. 161-174, 1950. A thorough survey of the past hypotheses and current problems dealing with the orogin of the earth. Clear illustrations are given for the hypotheses of Kant, Laplace, Chamberlin-Moulton, Jeans-Jeffreys, Lyttleton, Hoyle, Berlage, Alfvèn, and Weizsacker.

STANDARDS FOR GRADING TEXTURE OF EROSIONAL TOPOGRAPHY. Kenneth G. Smith. **Am. Jour. Sci.,** v. 248, no. 9, p. 655-668, Sept. 1950. "A study of texture, or drainage density, of stream-eroded topography was made to derive a ratio which will grade the texture on contour topographic maps and to establish limiting values of this ratio for "coarse," "medium," and "fine" texture. Standard values are suggested for the three texture grades, based on the application of the derived texture ratio to type areas. The term "ultra-fine texture" is used to designate the extremely fine dissection of badland topography..."

SEISMOLOGY

GEOPHYSICAL INVESTIGATIONS IN THE EMERGED AND SUBMERGED ATLANTIC COASTAL PLAIN. (Part 5: Woods Hole, New York, and Cape May Sections). Maurice Ewing, J. L. Worzel, N. C. Steenland, and Frank Press. **Geol. Soc. Am. Bull.,** v. 61, no. 9, p. 877-892, Sept. 1950. "Seismic refraction measurements from the coast line to the edge of the continental shelf were made along three lines of traverse: near Cape May, N. J., New York, N. Y., and Woods Hole, Mass., respectively. An unconsolidated layer with velocity about 5800 ft/sec, a semiconsolidated layer with velocity about 11,500 ft/sec, and a layer, considered to be the basements, with velocity about 18,000 ft/sec. were traced across each traverse..." "The standard method of seismic refraction has disclosed the existence of a depression in the surface of the crystalline rocks beneath the submerged Atlantic Coastal Plain. This depression is filled with semi-consolidated sediments of probable pre-Upper Cretaceous age .."

THE PHOTOELECTRIC SEISMOGRAPH. Joseph A. Volk. **Seismol. Soc. Am. Bull.,** v. 40, no. 3, p. 169-174, July 1950. A description of a new visually record-

ing seismograph, which overcomes the difficulties encountered in combining a photoelectric cell with a suitable amplifier and ink recorder.

SEISMIC REFRACTION MEASUREMENTS IN THE ATLANTIC OCEAN BASIN. (Part 1). Maurice Ewing, J. L. Worzel, J. B. Hersey, Frank Press, and G. R. Hamilton. **Seismol. Soc. Am. Bull.,** v. 40, no. 3, p. 233-242, July 1950. "A reversed seismic refraction measurement was made 120 miles northwest of Bermuda (400 miles east of Cape Hatteras) in 2,800 fathoms of water. A velocity of 24,800 feet per second (7.58 km/sec.) for the second layer was identified with the ultrabasic layer of earthquake seismology. Assuming a velocity of 5,600 feet per second (1.70 km/sec.), clearly indicated by earlier measurements, a thickness of 4,500 feet was obtained for the sedimentary layer. The granitic and intermediate layers were absent".

VOLCANIC TREMOR (Part 2: The Theory of Volcanic Tremor). Gut C. Omer, Jr. **Seismol. Soc. Am. Bull.,** v. 40, no. 3, 169-174, July 1950. "It is proposed that volcanic tremor originates in the vibration of laminae which are partly freed by the differential tilting of the surface of the earth around a volcanic vent during an eruption. The topographic evidence around Kilauea caldera is examined and a probable range of the free vibrating lengths is determined. The various possible modes of vibration are considered and it is concluded that longitudinal vibration would best explain the observed seismograms."

THE UNIVERSITY OF PITTSBURGH PEN-AND-INK RECORDING SEISMOGRAPH. Eugene I. Sulkowski. **Seismol. Soc. Am. Bull.,** v. 40, no. 3, p. 165-168, July 1950. An outline on the development of a high-magnification pen-and-ink recording seismograph. It records the output of a Wenner seismometer but may be adapted to other seismometer-galvanometer systems.

MINERALOGY, PETROLOGY, PETROGRAPHY, ETC.

ARCTIC GEMS. D. S. M. Field. **Gemmologist,** v. 19, no. 229, p. 177-179, Aug. 1950. The following minerals are described: cordierite and garnet from Garnet Island; rose quartz from Amadjak Bay; diopside and scapolite from MacDonald Island; Spinel from Baffin Land; and Lapis Lazuli from Baffin Island.

THE CHEMICAL KINETICS OF THE KATMAI ERUPTION. C. N. Fenner. **Am. Journ. Sci.,** v. 248, no. 9, p. 593-627, Sept. 1950. "In papers published several years ago, I gave a description of the pumices ejected in the great eruption of Mount Katmai in 1912. These pumices, in innumerable specimens, show remarkable associations of contrasting felsitic and mafic material, an effect that was ascribed to the assimilation of basic rocks by the new siliceous magma. This view aroused skepticism among geologists as to whether assimilation on such a large scale were credible. In the present article the possibilities of exothermic reactions in the magma are explored, and the large quantities of heat that may be developed are indicated. This conclusion is based upon well-recognized chemical principles, but whatever might be deduced in this manner, the real basis for conclusions is pre-eminently the pumices themselves. Therefore, the greater part of the present paper is devoted to detailed descriptions of their field relations, their petrography, and their chemistry, from every relevant standpoint. Most of the evidence presented is new. It points directly and unmistakably to the assimilation of great quantities of basic rock by the new magma..."

HIGH-TEMPERATURE ALBITE AND CONTIGUOUS FELDSPARS. O. F. Tuttle and N. L. Bowen. **Jour. Geology,** v. 58, no. 5, p. 572-583, Sept. 1950. "Synthetic

albite is found to have X-ray and optical properties different than those of the very pure natural albites from pegmatites, but these natural albites can, by heating, be converted into a form identical with the synthetic product. High- and low-temperature modifications are thus indicated...."

THE SYSTEM $NaAlSi_3O_8$-$KAlSi_3O_8$-H_2O. N. L. Bowen and O. F. Tuttle. **Jour. Geology**, v. 58, no. 5, p. 489-517, Sept. 1950. "In the presence of water vapor under pressure, soda feldspar and potash feldspar crystallize readily from their glasses. At high temperatures they appear to form a complete series of solid solutions showing continuous variation of lattice-spacing as measured by X-rays. Studies of the dry melts had indicated that the solid solutions are of the type having a minimum-melting mixture..." Previous investigations, experimental methods, apparent unbroken series of solid solutions at high temperatures, equilibrium diagrams at various pressures of water vapor, water content of the liquid phase, leucite field, solvus, behavior of natural alkali feldspars, general considerations of equilibrium, isobars and isotherms on the saturation surfaces, the course of crystallization, and petrologic considerations are the topics treated in this article.

HISTORICAL GEOLOGY

THE NATURE AND RELATIONSHIPS OF THE PALEOZOIC MICROSAURS. Alfred S. Romer. **Am. Jour. Sci.**, v. 248, no. 9, p. 628-654, Sept. 1950. "An attempt is made to establish a series of characters whereby the small Paleozoic tetrapods usually termed microsaurs may be defined. A considerable number of Carboniferous and early Permian genera belong to this category, but other genera which have frequently been included do not pertain. Although the "type" microsaur, **Hylonomus**, is among the forms excluded, it seems best to retain the familiar ordinal term Microsauria for the group as here defined. The microsaurs appear to have no relationship to reptiles, but are possibly ancestral to the urodele and apodous amphibians."

PREHISTORIC PATCHWORK. Eleanor Harvill. **Steelways**, v. 6, no. 5, p. 32, Sept. 1950. A short feature on the retired "chief of fossil fixers" for the American Museum of Natural History, Charles Lang. Problems in the mounting of dinosaurs are briefly mentioned.

REMAINS OF LAND MAMMALS FROM THE MIOCENE OF THE CHESAPEAKE BAY REGION. C. Lewis Gazin and R. Lee Collins. **Smithsonian Misc. Coll.**, v. 116, no. 2, p. 1-22, Oct. 12, 1950. A systematic description of the mammalian remains (Orders **Carnivora, Proboscidea, Perissodactyla, Artiodactyla**) in the marine deposits, for the most part from the Calvert formation. Geologic relations and age and faunal relationships are discussed.

ECONOMIC GEOLOGY

BIOGEOCHEMICAL INVESTIGATIONS IN THE TRI-STATE DISTRICT. John W. Harbaugh. **Econ. Geology**, v. 45, no. 6, p. 548-567, Sept.-Oct. 1950. "...Biogeochemical surveys based upon average zone concentrations from large numbers of plant analyses appear to offer promise in prospecting for concealed mineralization in the Tri-State district, particularly within the outcrop area of the 'Boon' limestone."

GROUND-WATER INVESTIGATIONS IN THE UNITED STATES. A. N. Sayre. **Smithsonian Rpt. for 1949**, p. 219-226, 1950. The problems of water supply, water control, and conservation are outlined, followed by a discussion of current ground-water investigations.

New Books

All books listed here are deposited in the Library of The Earth Science Institute and may be borrowed by the members. Books marked with an asterisk may be purchased through The Earth Science Publishing Co., Revere, Mass.

*BOTANY — An Evolutionary Approach. R. Stanley Gibbs. 1950. xiv, 554 p., 118 pls., 261 figs.; $6.00. (The Blakiston Co., Philadelphia).

Featuring the classical approach to this subject, the sequence of evolution from the simple primitive to the modern complex plant is followed as the order of presentation. Of special interest to the earth scientist are chapters on the soil, and evolution and genetics. The latter chapter contains a concise summary of the history of thought on evolution, the mechanism of evolution, and the fundamentals of genetics. "Suggestions for further study", following each chapter, contain a large number of constructive projects and, with the extensive index, add greatly to the value of this book as a text and reference book at the university level.

*CONSERVATION OF NATURAL RESOURCES, Guy-Harold Smith, Editor. 1950. xii, 552 p., 164 figs; $6.00. (John Wiley & Sons, Inc., New York).

The combined work of 20 men, this book is a comprehensive study of the problem of conservation — of soil, water, minerals, and other natural resources. Chapters on Conservation in the Mineral Kingdom, by W. M. Myers; The Mineral Fuels, by E. Willard Miller; The Great Soil Groups and Their Utilization, by Louis Wolfanger; and Soil Conservation, by William A. Rockie, contain much valuable reading matter. Selected references follow each chapter; a list of general works is appended. It is interesting to note the different degrees of concern about our resources expressed by the contributors, varying from deep pessimism to occasional notes of optimism.

GEOLOGY OF THE COASTAL PLAIN OF NORTH CAROLINA. Horace G. Richards. 1950. 84 p., 76 figs.; $1.50. (Tr. Am. Philos. Soc., v. 38, pt. 1, Philadelphia).

This report covers the area east of the "Fall Line", although the Coastal Plain area cannot be precisely defined because of the overlapping of some of the sediments onto the Piedmont Plateau. All the formations from the Cretaceous to the Recent are treated in detail, with emphasis on the Cenozoic deposits. The problem of the "Carolina Bays" is summarized. Included in the text are sections on the geologic structure, economic geology, and historical geology of the region. The bibliography contains an extensive list of references on the geology and paleontology of North Carolina published since 1912.

PENNSYLVANIAN SPORES OF ILLINOIS AND THEIR USE IN CORRELATION. Robert M. Kosanke. 1950. vi, 128 p., 18 pls., 7 figs.; free. (Bull. 74, Illinois State G. S., Urbana).

The determination of the feasibility of correlating Illinois coal beds by means of plant spores, and the provision of a paleobotanical basis for this correlation were the main objectives of this investigation. 5 new genera and 100 new species are described in this report, making a total of 19 genera and 130 species are described in this report, making a total of 19 genera and 130 species identified from coal beds in 47 counties. 28 species are restricted to one or another single coal bed, 16 species to two coal beds, and 23 species to three coal beds. In addition, several genera and many species have significant ranges. The vertical distribution of isopores, microspores, and prepollen provide a means of specific identification of coal beds. Correlations are indicated in the text.

OTHER PUBLICATIONS RECEIVED

DEVELOPMENTS IN ILLINOIS AND INDIANA IN 1949. Alfred H. Bell and R. E. Esarey. 1950. 14 p., 1 fig.; free. (Ill. Petroleum, 61, Ill. State G. S., Urbana). There were 526 producing oil wells, 37 gas wells, and 727 dry holes; in all, 62 new discoveries in 1949.

RATE OF DEPLETION OF WATER-BEARING SANDS. Frederic H. Kellogg. 1950. 16 p., 2 figs.; free. (Bull. 70, Miss. State G. S., University). A correction of the formulae for the computation of the rate of groundwater depletion.

ALEXO AND SAUNDERS MAP-AREAS, ALBERTA. O. A. Erdman. 1950. viii, 100 p., 8 pls., 5 figs.; $1.00. (Mem. 524, G. S. of Canada, Ottawa). Adjoining map-areas within the Foothills belt of west-central Alberta, lying in potential territory for oil and gas accumulations and coal deposits.

MINES OF ONTARIO IN 1948. I. Williams. 1950. iv, 112 p., free (Ann. Rpt. v. 58, pt. 2, 1949, Ontario Dept. of Mines, Toronto). Primarily on gold, silver and cobalt mines; also includes copper, feldspar, fluorspar, graphite, gypsum, iron, lead, zinc, magnesium, mica, nepheline syenite, nickel, talc, and metallurgical works.

FIEDMONT MAP-AREA, ABITIBI COUNTY, QUEBEC. L. P. Tremblay. 1950. viii, 114 p., 6 pls.; 11 figs.; $0.75. (Mem. 253, G. S. of Canada, Ottawa). Deals with the geology and mineral deposits (gold, molybdenite, spodumene, beryl) of the area, particularly the Lacorne mine, which has produced almost 5,000,000 pounds of molybdenite and 30,000 pounds of bismuth.

THE DRYAS FLORA OF KROSCIENKO ON THE RIVER DUNAJEC. M. Klimaszewski, W. Szafer, B. Szafran, and J. Urbanski. 1950. 104 p., 4 pls., 7 figs. (Bull. 24, 2nd ed., Geologic Institute of Poland, Warsaw).

BUILDING ROCKS IN POLAND. Marian Kamienski. 1949. 134 p., 1 pl., 21 figs. (Bull. 57, Geologic Institute of Poland, Warsaw).

Reports On Fluorimetric Uranium Determination Released

WASHINGTON, Oct. 12 — Three reports on methods of fluorimetric determination of uranium in low-grade ores have been completed by U. S. Geological Survey geochemists. They embody preliminary results of work on radioactive materials being carried on by the Survey on behalf of the Atomic Energy Commission.

The fluorimetric method for the determination of uranium in low-grade materials is now used in many laboratories in the United States. This method involves isolating chemically a uranium compound that fluoresces under ultraviolet light. The fluorescence is measured in an instrument called a fluorimeter. The amount of fluorescence is proportional to the amount of uranium present, a relationship that forms the basis for a quantitative method of analysis. Research in the fluorimetric method of analysis and in the improvement of fluorimetric design is of great importance in the rapid determination of uranium content.

Entitled "The rapid fluorimetric determination of uranium in low-grade ores," by F. S. Grimaldi and Harry Levine; "A transmission fluorimeter for use in the fluorimetric method of analysis for uranium," by Mary H. Fletcher, Irving May, and Morris Slavin; and "An improved fluorimeter for the determination of uranium in fluoride melts," by Mary H. Fletcher and Irving May, they have been placed in open file for public inspection in the Geological Survey Library, Room 1033, General Service Administration Building, Washington, D. C.

WATER RESOURCES

SEPTEMBER 1950

WASHINGTON, October 9 — Continued drought in Arizona, southern California, and part of New England, and generally high runoff for most of the United States east of the Rockies, characterize the monthly water situation as reviewed for September by the U. S. Geological Survey.

Ground-water levels are still declining and record lows were reported for many observation wells in Santa Barbara County, Calif., according to the **Water Resources Review.** This includes one well where the records have been kept since 1919. Heavy drains were reported on reservoirs in other parts of the state and the total storage at the end of the month was only about 50 percent of capacity (not including Lake Shasta).

In Arizona, stream flow continued generally deficient and combined storage in the Salt-Verde Reservoir system decreased to 55 percent of average. There is only 650 acre-feet of water left in the San Carlos Reservoir compared with the average of 138,500 acre-feet.

In New England, runoff during September increased somewhat in the northern half of the district, but reverted to drought conditions in Massachusetts and Rhode Island. Rainfall was spotty, averaging only about 60 percent of normal for Central New England. Water in storage remained about the same as last month.

In contrast, the runoff in the United States east of the Rockies was generally very high for September. Stream flow at 12 gaging stations was the highest ever recorded for that month, although quite low compared with the high flows that normally occur at other seasons.

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New Books

The following books were not listed in our complete catalog of books on the earth sciences, which appeared in the Earth Science Digest from June 1949 to January 1950.

THIS EARTH OF OURS by C. W. Wolfe. 1950. 384 pp., 239 figs.	$ 5.00
THE CAVE BOOK by Charles E. Hendrix. 1950. 68 pp., 34 figs.	1.00
STRUCTURAL PETROLOGY OF DEFORMED ROCKS by H. W. Fairbarn. 1949. 344 pp., 213 figs.	12.50
REBELLIOUS RIVER by J. P. Kemper. 1949. 279 pp., 7 figs.	6.00
APPLIED SEDIMENTATION edited by Parker D. Trask. 1950. 707 pp., 114 figs.	5.00
GRASSLAND HISTORICAL STUDIES by James C. Malin. Vol. I: Geology and Geography. 1950. 377 pp., 5 figs.	2.50
GEOCHEMISTRY by Kalervo Rankama and Th. G. Sahama. 1950. 912 pp., 50 figs.	15.00
INTRODUCTION TO THEORETICAL IGNEOUS PETROLOGY by Ernest E. Wahlstrom. 1950. 366 pp., 155 figs.	6.00
APPLIED HYDROLOGY by Ray K. Linsley Jr., Max A. Kohler, and Joseph L. H. Paulhus. 1949. 689 pp., 329 figs.	8.50
CRYSTALS AND X-RAYS by Kathleen Lonsdale. 1949. 199 pp., 13 pls., 138 figs.	3.75
GEOLOGY APPLIED TO SELENOLOGY — IV: THE SHRUNKEN MOON by J. E. Spurr. 1949. 207 pp., 36 figs.	4.00
A NEW THEORY OF HUMAN EVOLUTION by Sir Arthur Keith. 1949. 451 pp., 1 fig.	4.75
INTRODUCTION TO COLLEGE GEOLOGY by Chauncey D. Holmes. 1949. 429 pp., 312 figs.	4.00
THE ART OF THE LAPIDARY by Francis J. Sperisen. 1950. 382 pp., 1 pl., 406 figs.	6.50
GEOLOGY FOR ENGINEERS by Joseph M. Trefethen. 1949. 620 pp., 242 figs.	5.75
HYDROLOGY by C. O. Wisler and E. F. Brater. 1949. 419 pp., 132 figs.	6.00
NORTHWEST GEM TRAILS by H. C. Dake. 1950. 80 pp., 14 figs.	2.00

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